

Disclosure of the Invention**IAP20 Rec'd PGT/PTO 11 JAN 2006****Problems to be Solved by the Invention**

[0003] Research has been eagerly done on the Stirling engine for higher performance and lower cost.

[0004] In view of the foregoing, an object of the present invention is to reduce the number of components needed to build a Stirling engine, and thereby to simplify the structure and reduce the cost thereof.

Means for Solving the Problem

[0005] To achieve the above object, according to the present invention, a Stirling engine is structured as follows: in a Stirling engine including a displacer that moves inside a cylinder between a compression space and an expansion space and a piston that is made to reciprocate inside the cylinder by a driving force source, wherein the piston reciprocates to cause the displacer to reciprocate to cause working gas to move, a spring for causing the piston to resonate is eliminated, and rotation preventing means is provided for preventing the piston from rotating about an axis thereof inside the cylinder.

[0006] With this structure, no spring is used for the piston, and thus the number of components lessens. As the number of components lessens, the cost of components lowers, and in addition, since the piston no longer needs to be coupled to a spring, and thus it no longer needs centering in the radial direction, the cost of assembly also lowers. As the number of components lessens, the overall structure is simplified, and thus the incidence of failure lowers.

[0007] In the structure above, the additional provision of the rotation preventing

means for preventing the piston from rotating about the axis thereof inside the cylinder brings the following benefits.

[0008] As the piston reciprocates, the working gas flows from the compression space to a bounce space outside the cylinder. To keep a proper pressure balance between the bounce space and the compression space, a return flow passage needs to be formed that permits the working gas to return from the bounce space to the compression space at predetermined timing during reciprocation. Preventing the piston from rotating about the axis thereof inside the cylinder permits the return flow passage to securely play its role.

[0009] Alternatively, according to the present invention, in a Stirling engine including a displacer that moves inside a cylinder between a compression space and an expansion space and a piston that is made to reciprocate inside the cylinder by a driving force source, wherein the piston reciprocates to cause the displacer to reciprocate to cause working gas to move, a spring for causing the piston to resonate is eliminated, and movement restricting means is provided for setting the limit of movement of the piston toward the bounce space.

[0010] With this structure, no spring is used for the piston, and thus the number of components lessens. As the number of components lessens, the cost of components lowers, and in addition, since the piston no longer needs to be coupled to a spring, and thus it no longer needs centering in the radial direction, the cost of assembly also lowers. As the number of components lessens, the overall structure is simplified, and thus the incidence of failure lowers. Moreover, the provision of the movement restricting means prevents the piston, now liberated from restraint with a spring, from popping out of the cylinder into the bounce space.

- [0011] The reason that a linear motor is used as the driving force source of the Stirling engine is that it permits the piston to reciprocate without the use of a movement conversion mechanism such as a crank combined with a connecting rod, and that it offers high efficiency.
- [0012] In a case where a linear motor is used as the driving force source as described above, setting the range of the reciprocation of the piston in such a way that the magnet of the linear motor remains present within the magnetic circuit helps keep the magnet of the linear motor present within the magnetic circuit.
- [0013] Moreover, according to the present invention, in the Stirling engine structured as described above, an elastic member for damping shock is arranged between the piston and the movement restricting means.
- [0014] With this structure, even if the piston collides with the movement restricting means, the shock is alleviated so as to prevent noise and damage to the mechanism. As the elastic member, an O-ring, a commonly available mechanical component, can be used. This makes the elastic member easy and inexpensive to procure. Moreover, since an O-ring is highly resistant to unusual temperatures, oil, chemicals, etc., even when it is exposed to pressurized working gas inside a pressure vessel, it is unlikely to deteriorate.
- [0015] In the Stirling engine structured as described above, it is preferable that a gas bearing is formed between the outer circumferential face of the piston and the inner circumferential face of the cylinder, and it is preferable that two or more of such gas bearings be arranged at an interval from one another along the axis of the piston.
- [0016] With this structure, since two or more gas bearings are arranged at an interval from one another along the axis of the piston, the piston does not incline with respect

to the cylinder while reciprocating. Thus, the piston and the cylinder are securely prevented from making contact with each other, thereby preventing friction between them and what may result therefrom such as an energy loss and a wear at where they make contact.

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Brief Description of Drawings

[0017] [Fig. 1] A sectional view of the Stirling engine of a first embodiment of the present invention.

[Fig. 2] A table showing the result of performance tests.

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[Fig. 3] A partial sectional view of the Stirling engine of a second embodiment of the present invention.

[Fig. 4] A partial sectional view of the Stirling engine of a third embodiment of the present invention.

[Fig. 5] A sectional view of the Stirling engine of a fourth embodiment of the present